METHOD AND APPARATUS USING MULTIPLE SENSORS IN A DEVICE WITH A DISPLAY

REFERENCE TO RELATED APPLICATION

[0001] The present invention claims priority from a U.S. Provisional application having serial No. 60/218,748, filed on Jul. 17, 2000 and entitled "METHOD AND APPARATUS USING MULTIPLE SENSORS IN A MOBILE DEVICE."

BACKGROUND OF THE INVENTION

[0002] The present invention relates to devices with displays. In particular, the present invention relates to computing and mobile devices.

[0003] Mobile devices, such as personal information managers (PIMs), cellular telephones, pagers, watches, and wearable computers typically include one or more buttons or touch screens through which the mobile device receives explicit instructions from the user. For example, the user can press buttons to explicitly instruct the device to enter a full-power mode, activate an application, or scroll through an image on the display.

[0004] Although the devices are responsive to information provided through such explicit instructions, they are generally not responsive to information that is present in the manner in which the device is being handled by the user. For example, the devices do not automatically enter a full-power mode, even when the user is holding the device in a manner that is consistent with wanting to use the device.

[0005] The reason these devices are not responsive to such handling information is that they typically are not equipped with the sensors needed to detect the information nor with the software needed to interpret the information.

[0006] Because these devices are generally not responsive to the manner in which the user is holding the device, the user is forced to enter explicit instructions into the device to achieve various functions. In light of this, mobile devices are needed that can sense how they are being handled in order to perform certain background functions that expand the functionality of the mobile device without requiring the user to perform any additional actions.

SUMMARY OF THE INVENTION

[0007] In a device having a display, at least one sensor signal is generated from a sensor in the device. One or more context values are then generated from the sensor signal. The context values indicate how the device is situated relative to one or more objects. At least one of the context values is then used to control the operation of one or more aspects of the device.

[0008] The invention includes several aspects. In one aspect, an image on a display is scrolled at a rate that is based on the difference between a current tilt angle and a tilt angle when tilt scrolling was activated. A further aspect of the invention adjusts the contrast of a display based on the tilt angle of the display.

[0009] Other aspects of the invention control the power mode of the device based on whether it is being handled, its orientation, and/or whether it is being gestured toward.

[0010] Still further aspects of the invention activate applications based on the device being in a particular orientation while being held by the user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is a block diagram of the components of a mobile device under one embodiment of the present invention.

[0012] **FIG. 2** is a bottom view of a mobile device of one embodiment of the present invention.

[0013] **FIG. 3** is a front view of the mobile device of **FIG. 2**.

[0014] **FIG. 4** is a back view of the mobile device of **FIG. 2**.

[0015] **FIG. 5** is a left side view of the mobile device of **FIG. 2**.

[0016] **FIG. 6** is a right side view of the mobile device of **FIG. 2**.

[0017] **FIG. 7** is a graph of distance between a user and a mobile device as a function of proximity sensor levels.

[0018] **FIG. 8** is a block diagram of components used to practice several embodiments of the present invention.

[0019] **FIG. 9** is a graph of left-right tilt versus forward-back tilt showing those tilt angles that activate an audio device.

[0020] **FIG. 10** is a front view of a mobile device in a portrait orientation.

[0021] **FIG. 11** is a front view of a mobile device in a landscape orientation.

[0022] **FIG. 12** is a chart showing the display orientations for various combinations of forward/back tilt and left/right tilt.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] **FIG. 1** is a block diagram of a mobile device **200**, which is an exemplary environment for embodiments of the present invention. Mobile device **200** includes a microprocessor **202**, memory **204**, input/output (I/O) components **206**, and a communication interface **208** for communicating with remote computers or other mobile devices. In one embodiment, the afore-mentioned components are coupled for communication with one another over a suitable bus **210**.

[0024] Memory **204** is implemented as a non-volatile electronic memory such as a random access memory (RAM) with a battery back-up module (not shown) such that information stored in memory **204** is not lost when the general power to mobile device **200** is shut down. A portion of memory **204** is preferably allocated as addressable memory for program execution, while another portion of memory **204** is preferably used for storage, such as to simulate storage on a disk drive.

[0025] Memory **204** includes an operating system **212**, application programs **214**, and an object store **216**. During operation, operating system **212** is preferably executed by processor **202** from memory **204**. Operating system **212**, in one preferred embodiment, is a WINDOWS® CE brand